

3. (Amended) The filter of claim 1, further comprising at least one additional filter element (~~2~~), wherein the surface of the additional element is hydroxylated relative to the bulk of the element.
4. (Amended) The filter of claim 1, further comprising at least two additional filter elements (~~1, 2~~), wherein the surface of the first additional element (~~1~~) has a nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than about 1.00, and the surface of the second additional element (~~2~~) is hydroxylated relative to the bulk of the element.
5. (Amended) The filter of claim 2, wherein the element (~~2~~) having the hydroxylated surface is interposed between the two elements (~~1, 1~~) having surfaces including the nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than about 1.00.
6. (Amended) The filter of claim 3, wherein the element (~~1~~) having a surface including the nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than about 1.00 is interposed between the two elements (~~2, 2~~) having hydroxylated surfaces.
7. (Amended) The filter of claim 1, wherein at least a portion of the surface of the element (~~2~~) hydroxylated relative to the bulk of the element is aminated relative to the bulk of the element.
8. (Amended) The filter of claim ~~4~~ 7, wherein another portion of the surface of the element (~~2~~) hydroxylated relative to the bulk of the element is aminated relative to the bulk of the element.
9. (Amended) The filter of claim 1, wherein the surface of the filter element (~~1~~) has a nitrogen-to-oxygen ratio in the range from at least about 0.2 to less than about 1.00.
10. (Amended) The filter of claim 1, wherein the filter element (~~2~~) with the hydroxylated surface includes at least one carboxyl group.
11. (Amended) The filter of claim 1, wherein the filter elements (~~1, 2~~) have a negative zeta potential at physiological pH.
12. (Amended) The filter of ~~any one of claims 1 and 7-11~~ claim 1, wherein the filter element (~~1~~) having the surface including the nitrogen-to-oxygen ratio comprises a porous fibrous leukocyte depletion medium having a first predetermined critical wetting surface

tension (CWST); and the filter element (~~2~~) having a hydroxylated surface comprises a porous fibrous leukocyte depletion medium having a second predetermined CWST.

15. (Amended) The filter of ~~any one of claims 1-14~~ claim 1, wherein at least one filter element has a CWST of at least about 90 dynes/cm.

16. (Amended) A filter device (~~100~~) for processing a biological fluid comprising:
a housing (~~25~~) having an inlet (~~20~~) and an outlet (~~30~~) and defining a fluid flow path between the inlet and the outlet; and
the filter of ~~any one of claims 1-15~~ claim 1 disposed in the housing across the fluid flow path.

20. (Amended) The filter device of ~~any one of claims 16-19~~ claim 16, wherein the filter is arranged to provide leukocyte-depleted plasma having about 1×10^3 leukocytes or less therein.

21. (Amended) The filter device of ~~any one of claims 16-20~~ claim 16, wherein the filter is arranged to provide platelet-depleted plasma having about 1×10^9 platelets or less therein.

22. (Amended) The filter device of ~~any one of claims 16-21~~ claim 16, wherein the filter substantially removes C3a from the biological fluid passing therethrough.

24. (Amended) A method for processing a biological fluid comprising:
passing a biological fluid through the filter device of ~~any one of claims 16-23~~ claim 16;
and obtaining the filtered fluid.

25. (Amended) A method for processing a biological fluid comprising:
passing a leukocyte-containing plasma-rich fluid through a filter (~~10~~) comprising at least two filter elements (~~1, 2~~), wherein the surface of one filter element (~~1~~) has a nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than about 1.00, and the surface of the other filter element (~~2~~) is hydroxylated relative to the bulk of the element; and
obtaining a filtered plasma-rich biological fluid substantially free of leukocytes and platelets.

26. (Amended) The method for processing a biological fluid according to claim 25, wherein passing the leukocyte-containing plasma-rich biological fluid through the filter

comprising passing the fluid through at least one additional filter element (~~2~~), wherein at least a portion of the surface of the element is aminated relative to the bulk of the element, and another portion of the surface of the element is hydroxylated relative to the bulk of the element.

27. (Amended) The method for processing biological fluid according to claim 25, wherein passing the leukocyte-containing plasma-rich fluid through the filter comprises passing the fluid through at least two additional filter elements (~~1, 2~~), the surface of one additional element (~~1~~) having a nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than about 1.00, and the surface of the other additional element (~~2~~) being hydroxylated relative to the bulk of the element.

28. (Amended) The method of ~~any one of claims 25-27~~ claim 25 wherein the filtered plasma-rich fluid is substantially free of C3a.

29. (Amended) The method of ~~any one of claims 25-28~~ claim 25 wherein the leukocyte-containing plasma-rich biological fluid comprises a platelet-poor biological fluid.

30. (Amended) The method of ~~any one of claims 25-29~~ claim 28, including collecting plasma-rich fluid in a downstream container without substantially activating C3a in the plasma-rich fluid.

PATENT

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For: BIOLOGICAL FLUID FILTER AND
SYSTEM

PENDING CLAIMS AFTER ENTRY OF PRELIMINARY AMENDMENT

1. A filter for processing a biological fluid comprising:
at least two filter elements wherein the surface of one filter element has a nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than about 1.00, and the surface of the other filter element is hydroxylated relative to the bulk of the element.
2. The filter of claim 1, further comprising at least one additional filter element, wherein the surface of the additional element has a nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than about 1.00
3. The filter of claim 1, further comprising at least one additional filter element, wherein the surface of the additional element is hydroxylated relative to the bulk of the element.
4. The filter of claim 1, further comprising at least two additional filter elements, wherein the surface of the first additional element has a nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than about 1.00, and the surface of the second additional element is hydroxylated relative to the bulk of the element.

5. The filter of claim 2, wherein the element having the hydroxylated surface is interposed between the two elements having surfaces including the nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than about 1.00.
6. The filter of claim 3, wherein the element having a surface including the nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than about 1.00 is interposed between the two elements having hydroxylated surfaces.
7. The filter of claim 1, wherein at least a portion of the surface of the element hydroxylated relative to the bulk of the element is aminated relative to the bulk of the element.
8. The filter of claim 7, wherein another portion of the surface of the element hydroxylated relative to the bulk of the element is aminated relative to the bulk of the element.
9. The filter of claim 1, wherein the surface of the filter element has a nitrogen-to-oxygen ratio in the range from at least about 0.2 to less than about 1.00.
10. The filter of claim 1, wherein the filter element with the hydroxylated surface includes at least one carboxyl group.
11. The filter of claim 1, wherein the filter elements have a negative zeta potential at physiological pH.
12. The filter of claim 1, wherein the filter element having the surface including the nitrogen-to-oxygen ratio comprises a porous fibrous leukocyte depletion medium having a first predetermined critical wetting surface tension (CWST); and the filter element having a hydroxylated surface comprises a porous fibrous leukocyte depletion medium having a second predetermined CWST.
13. The filter of claim 12, wherein the two filter elements have different critical wetting surface tensions (CWSTs).
15. The filter of claim 1, wherein at least one filter element has a CWST of at least about 90 dynes/cm.

16. A filter device for processing a biological fluid comprising:
a housing having an inlet and an outlet and defining a fluid flow path between the inlet and the outlet; and
the filter of claim 1 disposed in the housing across the fluid flow path.
17. The filter device of claim 16, wherein the filter is arranged to allow plasma to pass therethrough and substantially prevent the passage of leukocytes and platelets therethrough.
18. The filter device of claim 16, wherein the filter is arranged to allow plasma to pass therethrough and substantially prevent the passage of leukocytes therethrough, without substantially activating C3a in the biological fluid.
19. The filter device of claim 16, wherein the filter is arranged to allow plasma to pass therethrough and substantially prevent the passage of platelets, leukocytes, and C3a therethrough.
20. The filter device of claim 16, wherein the filter is arranged to provide leukocyte-depleted plasma having about 1×10^3 leukocytes or less therein.
21. The filter device of claim 16, wherein the filter is arranged to provide platelet-depleted plasma having about 1×10^9 platelets or less therein.
22. The filter device of claim 16, wherein the filter substantially removes C3a from the biological fluid passing therethrough.
24. A method for processing a biological fluid comprising:
passing a biological fluid through the filter device of claim 16; and obtaining the filtered fluid.
25. A method for processing a biological fluid comprising:
passing a leukocyte-containing plasma-rich fluid through a filter comprising at least two filter elements, wherein the surface of one filter element has a nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than about 1.00, and the surface of the other filter element is hydroxylated relative to the bulk of the element; and
obtaining a filtered plasma-rich biological fluid substantially free of leukocytes and platelets.

26. The method for processing a biological fluid according to claim 25, wherein passing the leukocyte-containing plasma-rich biological fluid through the filter comprising passing the fluid through at least one additional filter element, wherein at least a portion of the surface of the element is aminated relative to the bulk of the element, and another portion of the surface of the element is hydroxylated relative to the bulk of the element.

27. The method for processing biological fluid according to claim 25, wherein passing the leukocyte-containing plasma-rich fluid through the filter comprises passing the fluid through at least two additional filter elements, the surface of one additional element having a nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than about 1.00, and the surface of the other additional element being hydroxylated relative to the bulk of the element.

28. The method of claim 25 wherein the filtered plasma-rich fluid is substantially free of C3a.

29. The method of claim 25 wherein the leukocyte-containing plasma-rich biological fluid comprises a platelet-poor biological fluid.

30. The method of claim 28, including collecting plasma-rich fluid in a downstream container without substantially activating C3a in the plasma-rich fluid.

31. The filter of claim 1, wherein the surface of one filter element having a nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than 1.00 has a greater number of carboxyl groups relative to the bulk of the element.

32. A filter for processing a biological fluid comprising:
at least two filter elements, wherein the surface of one filter element has a greater number of carboxyl groups relative to the bulk of the element and the surface of the other filter element is hydroxylated relative to the bulk of the element.

33. The filter of claim 32, wherein the surface of the filter element having a greater number of carboxyl groups relative to the bulk of the element has a nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than about 1.00, and the filter has at least one first additional filter element, wherein the surface of the first additional filter element has a greater number of carboxyl groups relative to the bulk of the element and a nitrogen-to-oxygen ratio in the range of from at least 0.01 to less than about 1.00.

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